Final Report

Preliminary Site Selection Study Proposed Shootering Canyon Uranium Project, Utah

for

Plateau Resources Ltd
Grand Junction, Colorado

June 1977

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CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

The Shootering* Canyon mine under development by Plateau Resources Ltd. (PRL) is in southeastern Utah, north of Page, Arizona, and near the most northerly reaches of Lake Powell. The mine itself lies in the Salt Wash sandstone member of the Morrison Formation where it is exposed at outcrop on the southeastern end of the Henry Mountain depositional basin. Older mines, dating from the 1940s and earlier, removed relatively high grade uranium ore from horizontal drifts into the ore body as it outcropped several hundred feet above the floor of Shootering* Creek and its tributaries.

The present mining plan proposes to continue such drifts along the trend of mineralization. Because of hydrologic and slope stability problems in the canyon near the mine, it has been determined that a facility (and its associated tailings pond) to process the ore to yellowcake should be located elsewhere. This report deals with the efforts of Woodward-Clyde Consultants (WCC) to locate and identify potential facility and tailings impoundment sites in the Shootering Canyon vicinity.

WCC found a number of potential locations and reviewed the three additional locations suggested by PRL representatives for consideration. The most suitable sites were located south of the mine area within a mile of Highway 276 or the access road to the mine from the highway. Areas were sought that could easily provide sites for both facility and tailings pond in close proximity to each other and that would also provide reasonable access to the mine in terms of distance as well as uphill haulage requirements. Because of national concerns regarding

A variant of the given (and mapped) name of Shitamaring.

seepage losses, dam failure, and airborne dispersion of tailings materials, locations were sought that combined impermeable soils, stable geologic formations, and natural enclosures (thereby minimizing the length of the required dam, or dams, and providing reasonable protection from expected prevailing winds). Visibility from Highway 276, potential impact on water quality, proximity to present or planned communities in the area, and general environmental impact were also considered.

The potential locations that were considered ranged from the intersection of Routes 276 and 95 north of the Henry Mountains (about 26 miles southeast of Hanksville), southward to about 10 miles north of Lake Powell. The better sites were found in the general area of Hansen and Shootering creeks.

A prime site and two alternatives, each with somewhat differing characteristics and assets, are recommended by WCC for consideration by PRL, pending more adequate mapping by PRL to permit further engineering evaluation of the specific sites. These sites are listed below in order of their overall preference:

1. T36S, R11E, N29 and SE20 (Location 2)*
2. T36S, R11E, NE4 (Location 9)
3. T36S, R11E, NW4 (Location 10)

Each of the above appears, on the basis of available information, to be adequate for the purpose of siting a facility and tailings pond safely with minimal impact on the natural resources of the area while providing ready access from the PRL mine (or other mines, should ore-buying be included in the program). Each of the sites also appears to have sufficient capacity to permit storage of tailings from reserves considerably in excess of present estimates and to offer the opportunity for compartmentalization of the tailings impoundment, should that type of impoundment prove desirable during the active life of the facility.

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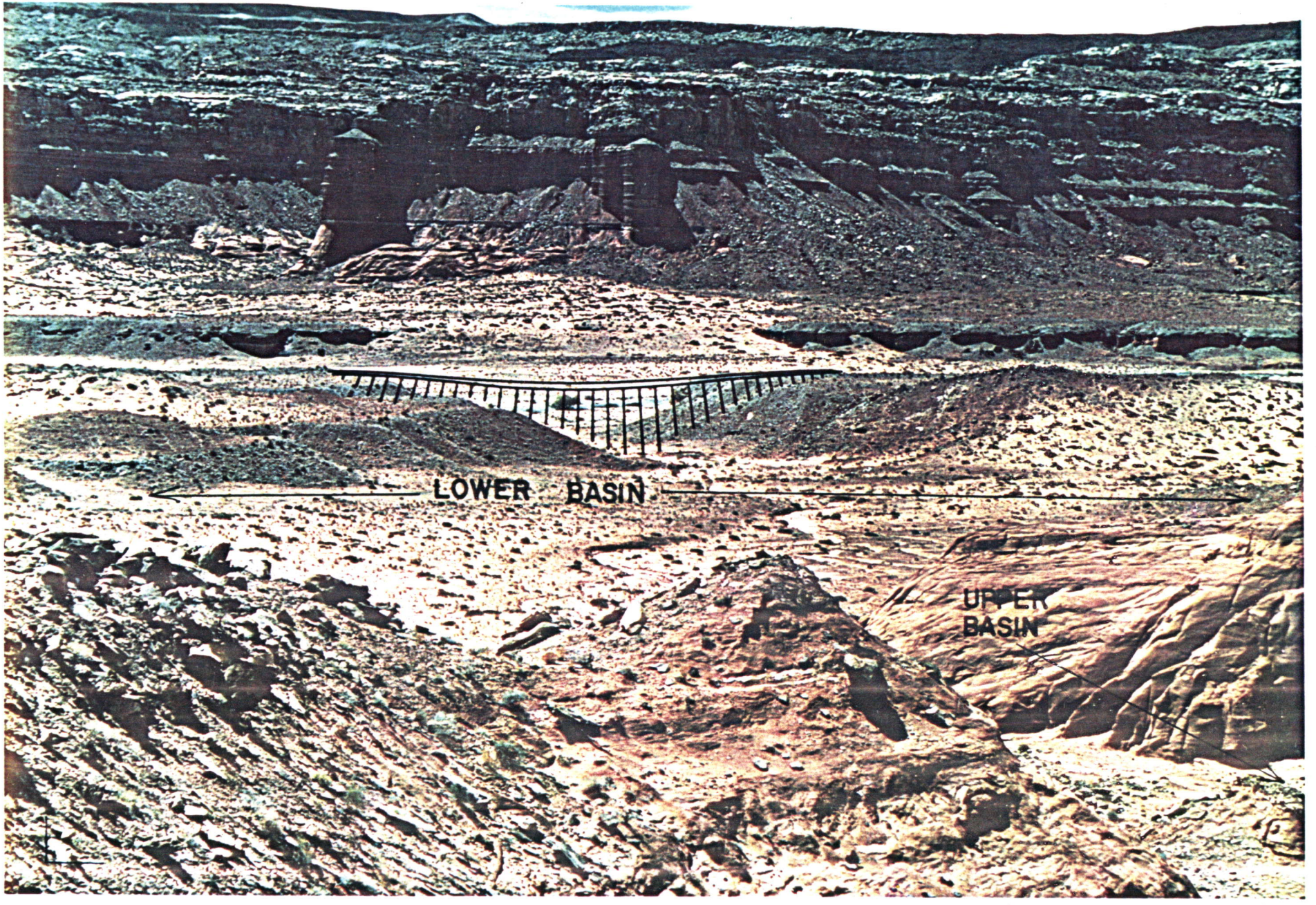
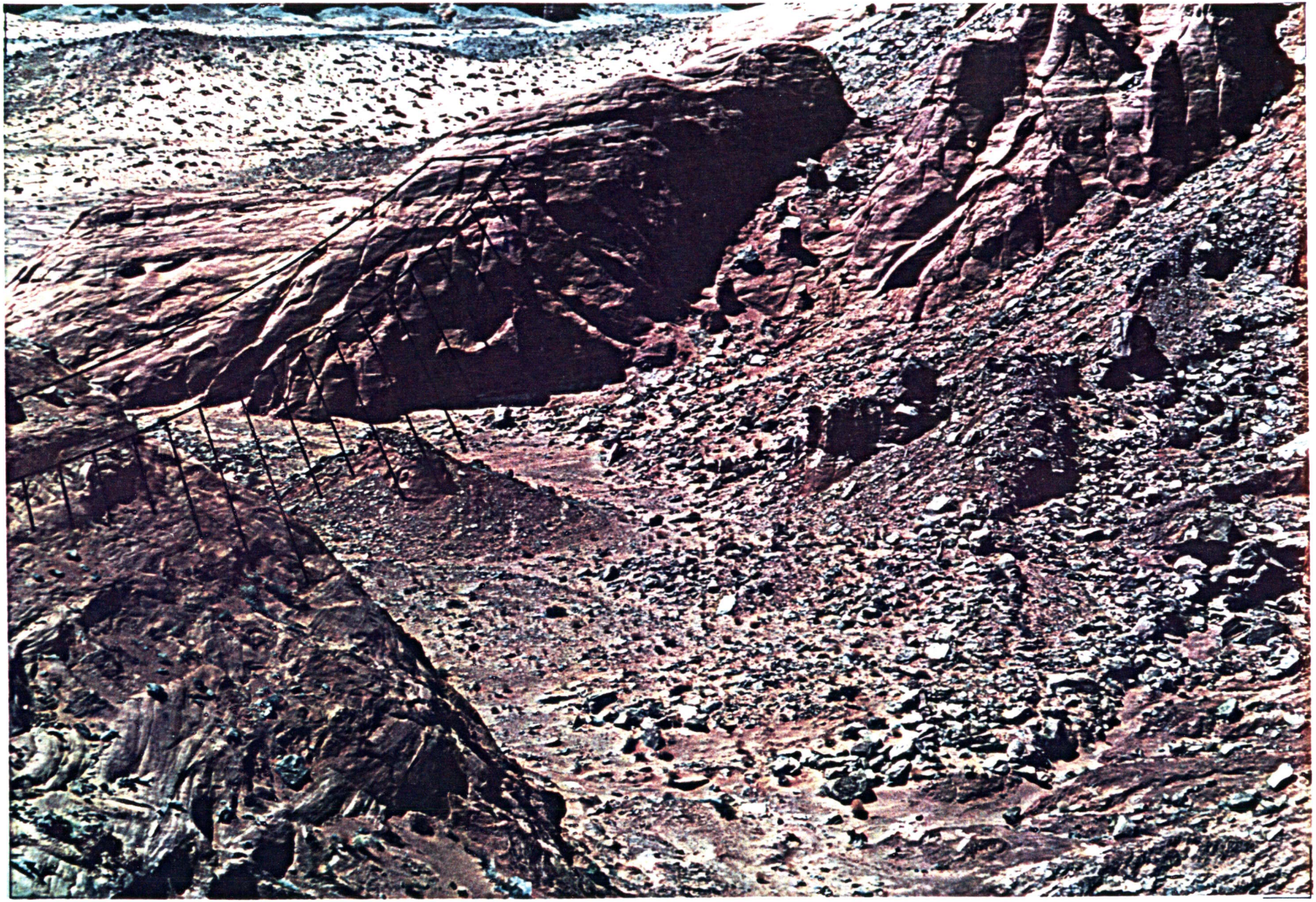
*Numbers in parentheses refer to location designations as discussed in this report.

Photographs taken of the three prime site locations follow this summary. Each is shown with an overlay sketch to indicate a potential dam location. Location 2 is shown with both a large lower basin and an upper impoundment to illustrate the potential for a staged operation or for deliberate tailings and liquor/slimes separation. This site provides excellent natural enclosure (nearly 60 feet at the dam) with considerable earth construction material nearby. The photograph for Location 9 shows only one of the potential impoundment developments of a series that could be developed across the length of this relatively large site. Others lie to the north (right) and south (left). Considerable opportunity for compartmentalization of this potential tailings impoundment exists in this sheltered location.

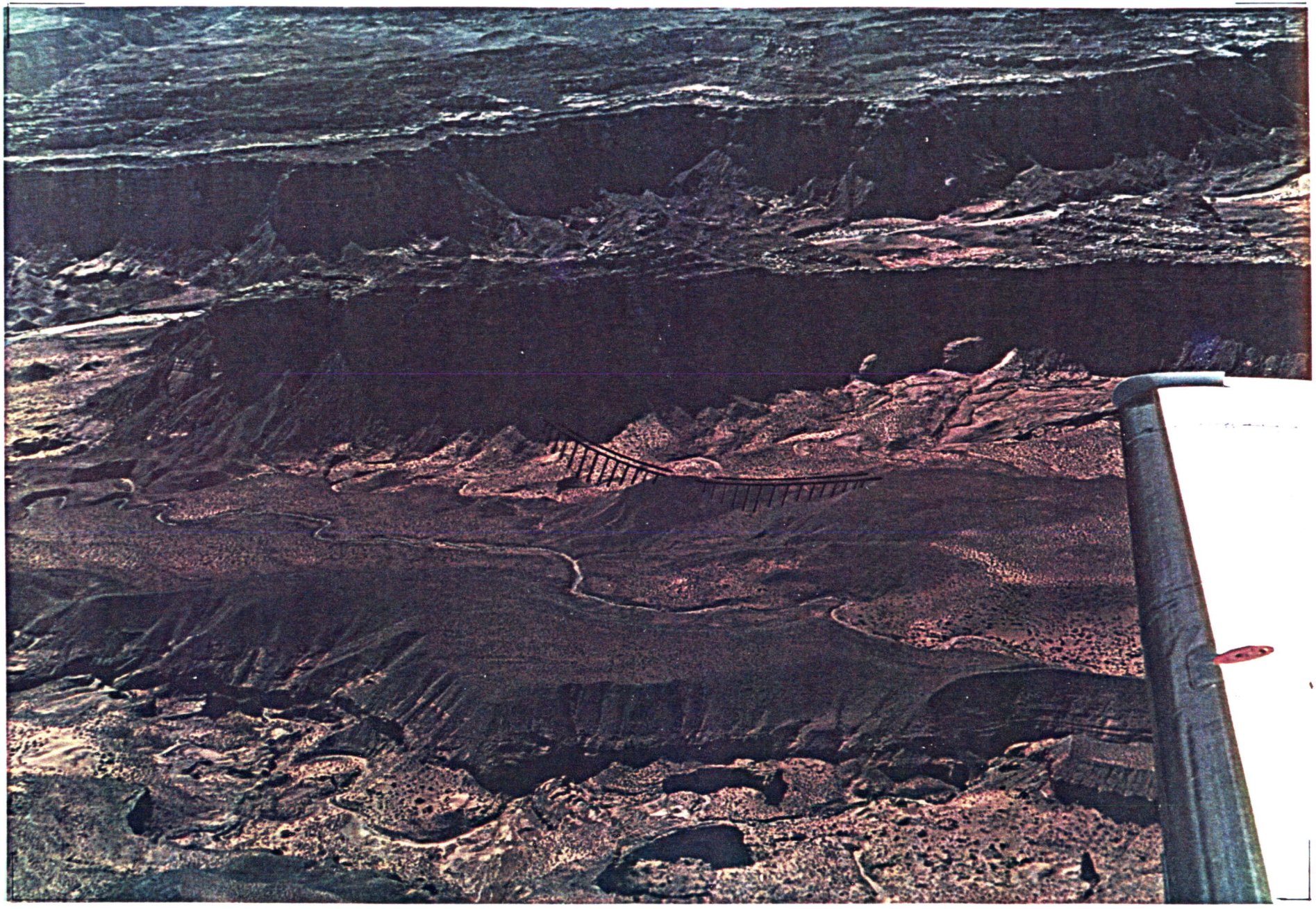
Location 10 lies across the bluff from Location 9 (i.e., to the west) in an erosional embayment next to Shootering Creek. This rather remarkable site offers a concise natural enclosure that could be easily developed in stages. Potential dam locations are shown to illustrate complete enclosure. An existing topographic separation between the two dammed areas could act as an interim berm during initial operations — or alternatively provide much of the earth materials needed for dam construction.



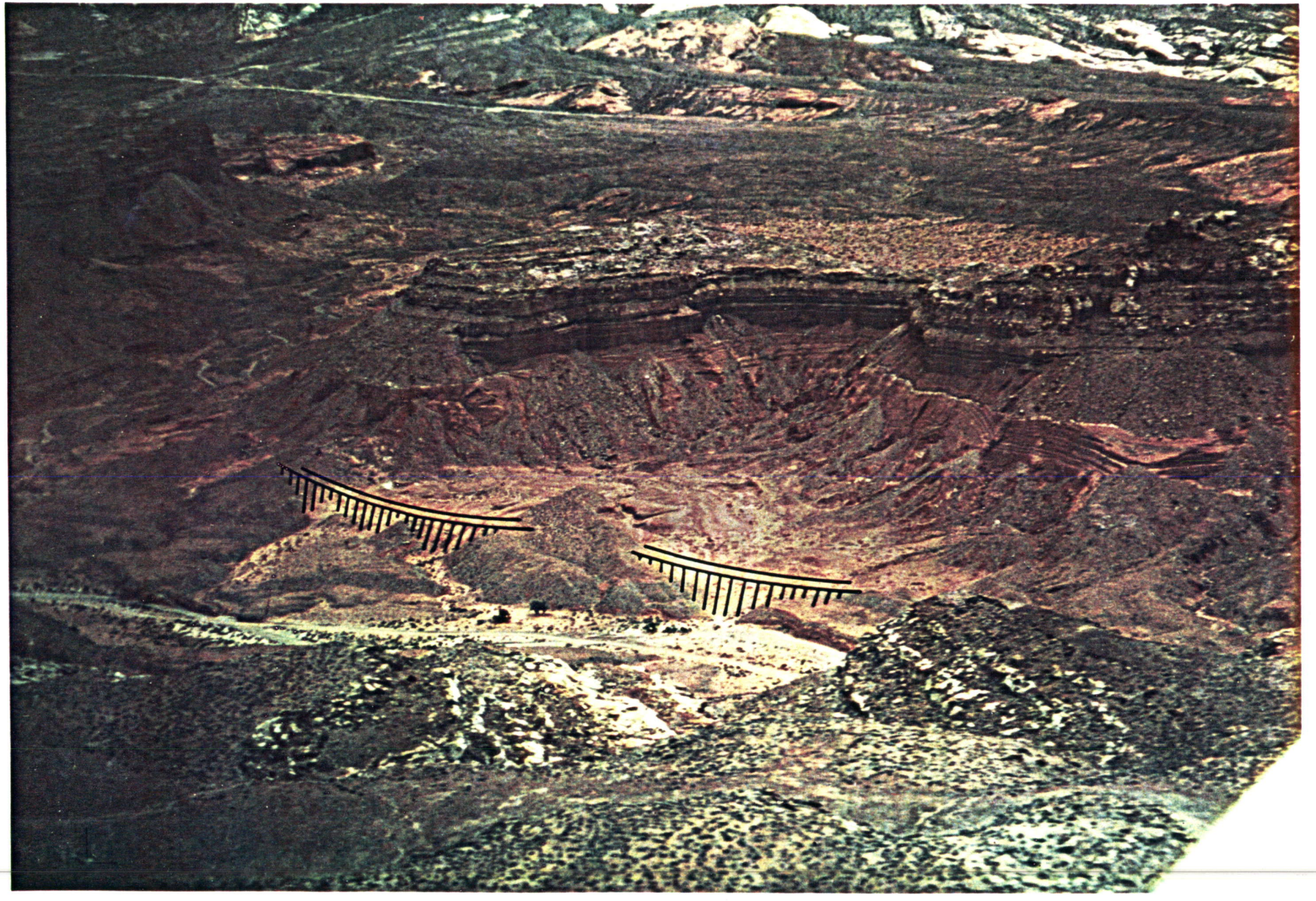
SITE 2 LOWER BASIN FROM EAST WITH POTENTIAL DAM SITE



SITE 2 POTENTIAL UPPER IMPOUNDMENT FOR TAILINGS SOLIDS SEPARATION



SITE 9 POTENTIAL DAM SITE FROM EAST



SITE 10 AERIAL VIEW FROM WEST SHOWING POSSIBLE DAM SITES

1

INTRODUCTION

This report describes a study to identify uranium facility and tailings impoundment sites in the vicinity of Shootering Canyon in southeastern Utah (Figure 1). The study was intended to rapidly focus on a few potential sites among the many possible locations in the study area where the likelihood of meeting safety, environmental, and economic objectives was relatively high.

All work was based on available published literature and on field visits by professionals in the fields of geology, geotechnical engineering, ecology, hydrology/water quality, and meteorology/air quality. Existing topographic maps for the study area are generally not adequate to permit detailed quantification of engineering, hydrologic, or meteorological site assessments. For this reason, site comparisons were primarily qualitative and were based on the professional judgments of individuals experienced in uranium facilities siting, environmental impact analysis, and licensing. The recommendations presented here should be considered conditional, subject to detailed mapping, surveys, coring, and field verification prior to any commitment to build.

BACKGROUND

Plateau Resources Ltd. proposes to construct uranium facilities to process ore from the existing mine in Shootering Canyon and from other independent mines in southeastern Utah. The facility is to consist of a 750-ton/day uranium plant, a tailings impoundment, and associated mechanical and personnel support facilities.

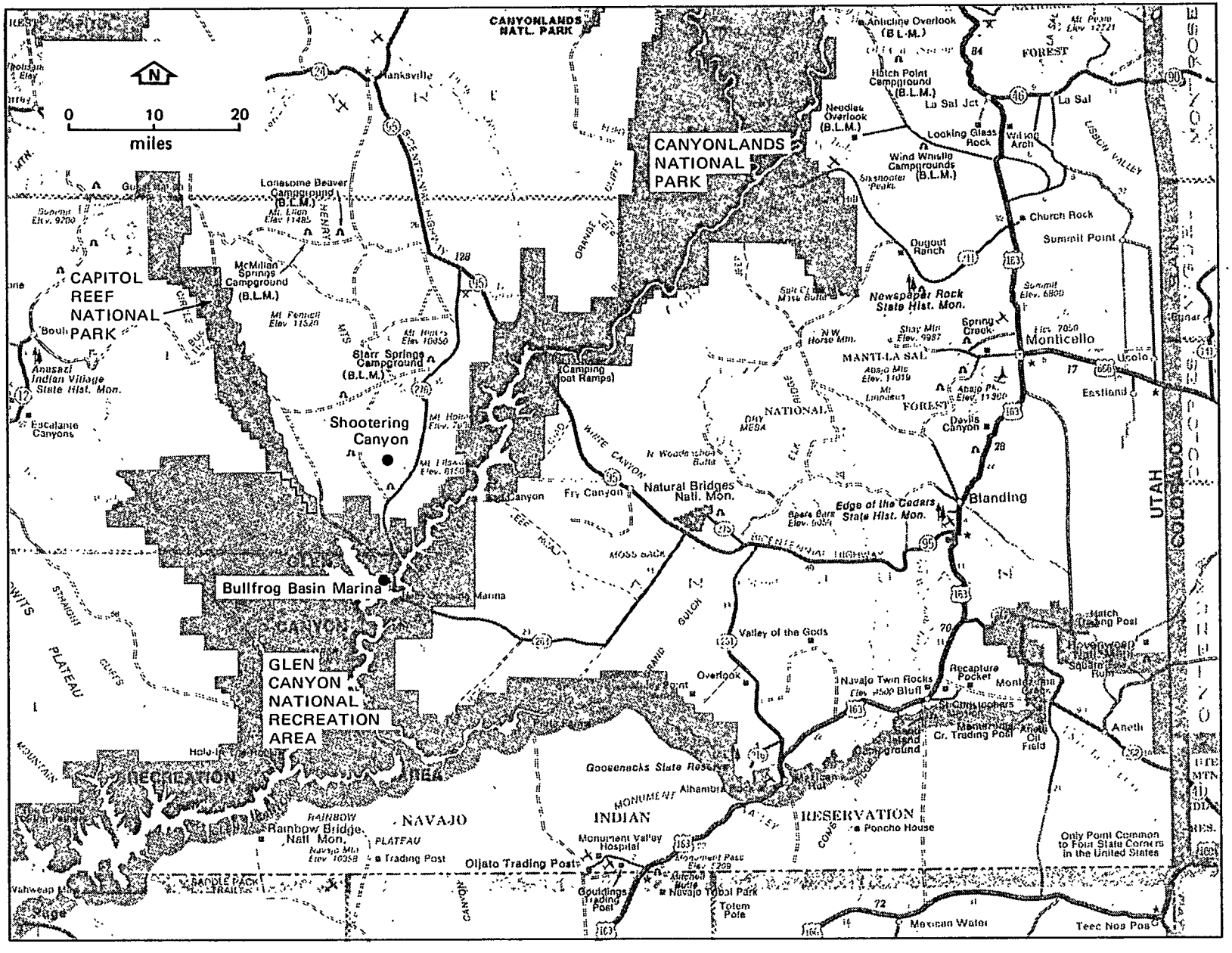


Figure 1. SOUTHEASTERN UTAH

The sites identified in this study were chosen on the basis of many considerations, including safety, environmental, geological, hydrological, and engineering/economic considerations. It is understood that the tailings impoundment is to have sufficient capacity for up to 20 years of operation at 750 tons/day (i.e., 5 million tons of ore). Process water for operations is not thought to be available from mine dewatering or from surface sources; the facility is understood to require development of an independent groundwater supply and delivery system. Furthermore, it was understood from our conversations with PRL representatives that the siting effort should attempt to minimize the visibility of the operation from public roads in order to preserve the scenic and recreational values of the area and to improve security of the facility (to prevent possible vandalism).

The selection of potential facility and tailings basin sites is the first of three phases of work commissioned by PRL; subsequent phases will involve site-specific baseline studies, the preparation of an environmental report on the chosen site, and assistance in preparing the requisite permit applications for submission to the appropriate governmental agencies.

PURPOSE AND ORGANIZATION OF REPORT

The purpose of this report is to briefly describe the approach, findings, and recommendations of the siting studies in the Shootering Canyon study area. It has been organized into the following five sections:

- an introduction
- a description of the siting approach
- a description of the screening process leading to the identification of potential sites
- a summary of site characteristics and a qualitative evaluation of potential sites
- conclusions and recommendations

To further document our study, information gathered during field reconnaissance is summarized in Appendix A in tabular form.

2

SITING APPROACH

Selection of a plant and tailings dam site requires consideration of the following concerns.

- A tailings site is a long-term structure requiring a relatively permanent commitment of land.
- Safety issues are very significant because of the tailings radioactivity.
- The economic investment may be high.
- This type of project has the potential for arousing public concern, and a selected site may have to be defended before regulatory agencies.

Because of the above factors, it is important to be judicious in identifying and studying potential locations for sites. Any approach to site identification, however, is constrained by time and the availability of data. The procedure adopted here is systematic and prudent with respect to the concerns mentioned above while recognizing the limittations of available data and time.

The general approach to identifying and evaluating sites for the study involved five major steps.

1. development and application of general and screening criteria to delineate a study area in which to look for sites
2. reconnaissance to further reduce the size of the study area and to identify a number of potentially acceptable site locations
3. reconnaissance of potential site locations to make specific assessments for further evaluation or screening

4. organization of the assessments to characterize the site locations for evaluation
5. evaluation of chosen sites to produce recommendations and conclusions

The general approach was designed to focus attention on those areas where the likelihood of finding acceptable sites would be relatively high and to quickly arrive at a number of such sites to provide a range of choice. Because of the limitations of existing data, detailed quantitative screenings and assessments were not possible within the allotted time. For this reason, qualitative assessments based on the professional judgments of experienced individuals were used to yield practical results that would form the basis for conditional recommendations. Each step of the siting approach will be discussed briefly below, with greater detail and results to be presented later in this report.

In the first step, the WCC site selection team established some general siting criteria for the plant and tailings impoundment. These consisted of a list of features that could characterize relatively desirable and undesirable areas. The criteria were applied using information obtained from maps and from published literature to define a study area.

In the second step, a brief field reconnaissance of the study area was conducted by a representative of WCC who has a multidisciplinary background, accompanied by a PRL representative. The purpose of the reconnaissance was to further reduce the size of the study area and then to identify a number of sites that seemed geotechnically suitable for a plant and tailings impoundment from an engineering point of view. Again, the emphasis was on surveying the more promising areas and quickly identifying potential sites.

In the third step, a team composed of a geotechnical engineer, an ecologist, a meteorology/air quality specialist, and a representative of PRL performed a field reconnaissance of the study area and the potential

sites. During this step, assessments were made concerning site characteristics that would influence cost, environmental impacts, and the meeting of regulatory requirements. As a result, some of the initial potential sites were screened out because of apparent drawbacks or anticipated difficulties.

The fourth step involved the organization of the reconnaissance assessments for the potentially acceptable sites into a format that would aid in a comparative evaluation of these sites. A list of geological, hydrological, geotechnical, meteorological, air quality, aesthetic, biological, and other characteristics was developed, and each site was described in terms of these characteristics. These descriptions were summarized in tabular form to allow a qualitative comparison of the sites.

The fifth step involved examining the results of the assessments for the purpose of recommending a few sites for further consideration by PRL. Sites that had the more favorable assessments in terms of the more important siting characteristics were considered for recommendation.

The sections that follow describe the implementation and results of the siting process in more detail.

3

SCREENING PROCESS

The purpose of the screening process was to systematically narrow the focus of the study to concentrate on relatively small areas where the probability of finding suitable sites was relatively high. Within these smaller areas, specific locations were then identified that met more detailed objectives related to safety, environmental impact, and cost. Screening at Shootering Canyon proceeded in the following steps: (1) delineation of a study area; (2) consideration of dominant regional influences on siting suitability; and (3) preferential selection of small areas with appropriate topographic configurations for siting. These potential siting areas were then visited by a multidisciplinary team, and relatively specific plant and tailings basin sites were identified.

The application of criteria in the screening process was organized around the following broad siting objectives:

- maximize public health and safety
- minimize environmental impacts
- minimize cost

As the areas under consideration for sites became smaller, these objectives were refined to refer to increasingly detailed siting considerations.

In Shootering Canyon, the controlling factor in facility siting was the location of the tailings impoundment, since stable foundations for the facility appeared to be widely available. Professional prudence and regulatory agency guidelines require that the impoundment dam be stable

and free from compromising effects of natural and man-made hazards for a long period of time. The overriding concern of tailings impoundment site selection is safety. Factors that must be considered include a potential dam or dike breach and the release of radioactive and other toxic materials as a result of a breach, flooding, or seepage.

In the initial stages of a siting study, the basic safety of an impoundment can be addressed in terms of the regional geologic and hydrologic setting. Following the delineation of a study area in the Shootering Canyon vicinity, the screening process concentrated first on identifying geologic and hydrologic constraints on impoundment safety and then on identifying tailings basin and plant combinations, with attention to more specific and localized safety, engineering, environmental, and cost considerations.

Delineation of Study Area

The Shootering Canyon study area was defined by natural and man-made boundaries and by practical considerations of proximity to the source of uranium ore. The initial study area shown in Figure 2 is bounded on the east, south, and southwest by the Glen Canyon National Recreational Area; on the west by the Capitol Reef National Park; and on the north by Mount Hillers and Mount Pennell. It was extended northeastward along Highway 276 to Highway 95 at PRL's request. The national recreation area and national park present statutory obstacles to industrial siting. To the north, Mount Hillers and Mount Pennell are rugged and present a natural obstacle to access.

Regional Considerations

The initial step of screening was conducted within the study area described above. Regional geologic and hydrologic criteria applied in this step were related to safety of the potential dam and were used

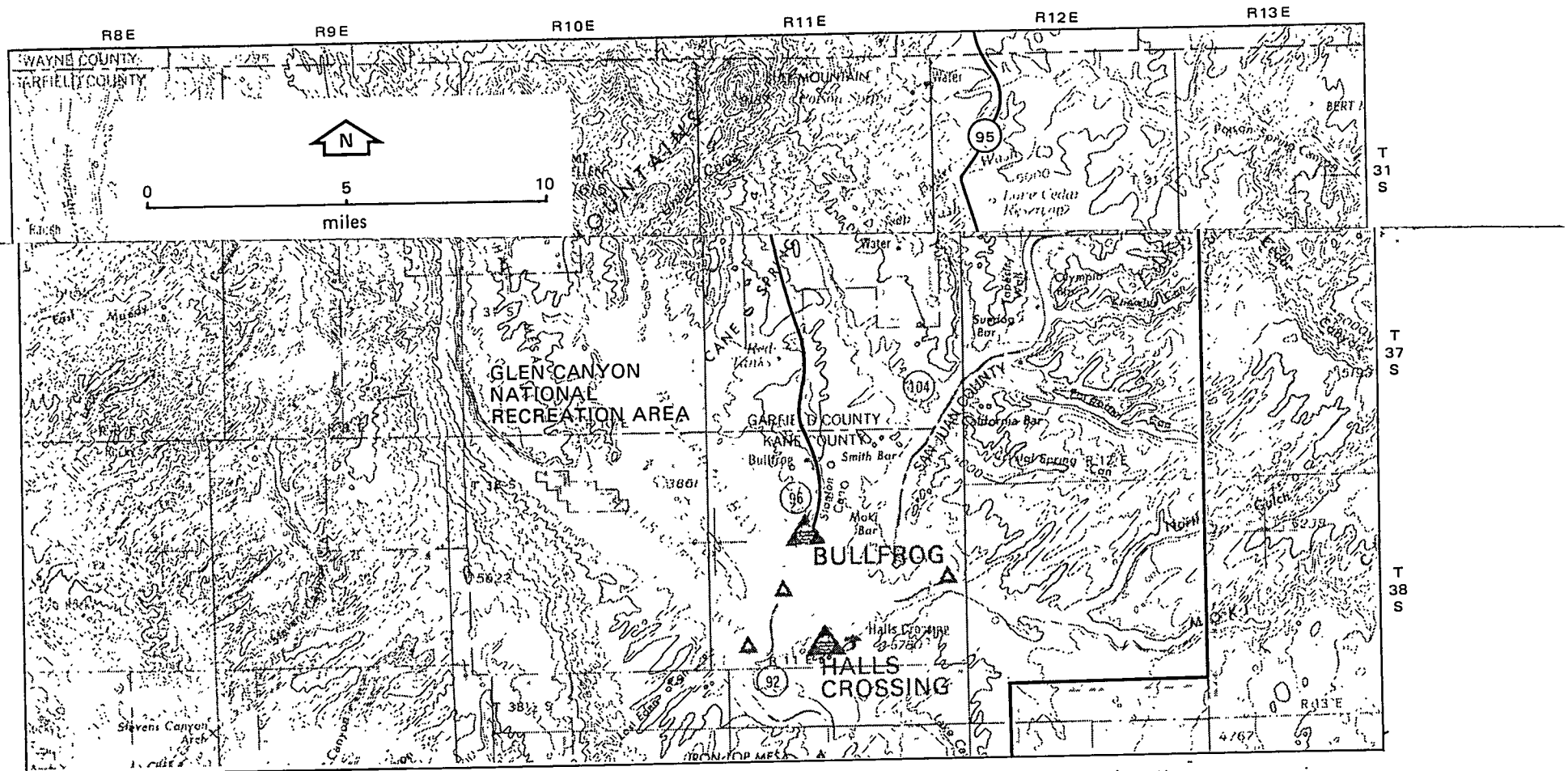


Figure 2. SHOOTERING CANYON STUDY AREA

to identify areas that were not generally suitable for tailings basin development. Ruggedness of terrain, accessibility, visibility from recreational highways (95 and 276), and proximity to local recreational sites were also considered during screening. Following are more specific descriptions of geologic and hydrologic considerations that were employed during screening. Figure 2 identifies portions of the original study area that were screened from further consideration and the final reduced study area.

Geology. The long-term integrity of the tailings basin dam requires, as a minimum, a stable geologic environment and competent foundation and abutment materials at or near the surface. Many of the surface and near-surface geologic formations in the vicinity of Shootering Canyon (particularly north and west of the canyon) contain weak or incompetent members. In addition, portions of some formations are faulted, fractured, or severely jointed. Consequently, geologic horizons such as the Brushy Basin and Mancos Shale were judged to be unsuitable for stable impoundment sites. After field inspection, land areas associated with these horizons were removed from further consideration in the study.

Two formations in the area that appeared to have desirable qualities of strength, stability, continuity, thickness, and shallow burial, as well as generally good engineering properties, are the Entrada Sandstone and the Summerville Formation, which outcrop in a north-south band roughly parallel to and encompassing the axis of Shootering Canyon and lower Hansen Creek (below its confluence with Shootering Creek). The land areas associated with these geologic horizons were examined in greater detail as screening proceeded.

Hydrology. Tailings impoundments that take advantage of natural drainage enclosures to provide capacity and minimize dam and embankment construction also may be susceptible to flooding from natural runoff. An initial safety objective in tailings impoundment siting is to identify and exclude from further consideration areas that are subject to

intense periodic storm flows or inundation. The very long life of a uranium tailings impoundment requires that high-volume flows of infrequent occurrence be considered in site selection and accounted for in facilities design. Consequently, prominent deep natural drainages that may at some time carry large volumes of flood waters, such as Shootering and Hansen canyons, are not suitable for tailings basin sites, despite the fact that they may be dry for years on end. In addition, portions of tributary drainages for which the catchment area is large enough to generate runoff volumes greater than can be reasonably managed by conventional diversion structures should also be excluded from consideration for tailings impoundment sites. These criteria were applied to the lands where the Entrada and Summerville formations outcropped to further reduce the area under consideration for sites.

Local Considerations

This step of screening focused on identifying basin-shaped topographic configurations that could be dammed to provide sufficient volume for the 20-year tailings output of a 750-ton/day plant. Selection of these basin areas was subject to several other criteria that bear on site suitability and that could be readily evaluated at this level of investigation.

The basin-shaped areas identified in this step were inspected in the field, where more site-specific observations were made. The locations of these areas are shown in Figure 3.

Topography. Numerous engineering, economic, and environmental advantages are associated with tailings basin development utilizing natural drainage channels. If there are no other geotechnical or environmental criteria to the contrary, an ideal topographic setting for a tailings basin is a small, protected upstream reach of a natural drainage, with

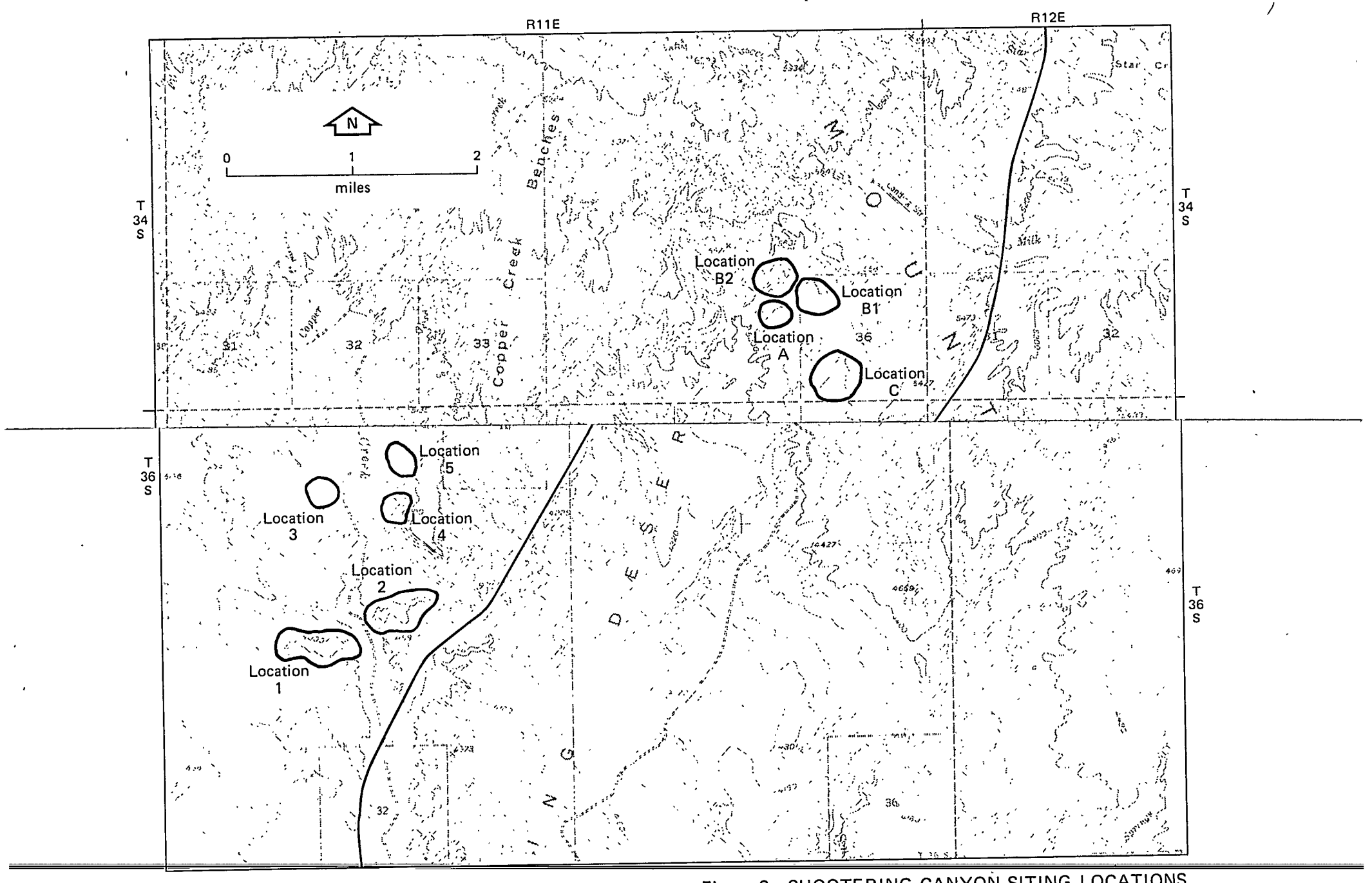


Figure 3. SHOOTERING CANYON SITING LOCATIONS

sufficient depth and area to provide the required storage capacity and an appropriate shape to minimize the amount of earthwork needed. The total amount of ore to be processed in the Shootering area was estimated to be of the order of 5 million tons, yielding about 2600 acre-feet of tailings. Assuming depths ranging from 30 to 50 feet, the minimum area required for a tailings basin was found to be about 75 to 100 acres. On the basis of topographic maps and a preliminary aerial reconnaissance of the area, a number of topographic settings that could provide the required storage capacity were identified. All of these areas were on tributary drainages to Shootering Canyon, generally south and east of the mine.

Meteorology, Visibility, and Flooding Potential. Brief surface reconnaissance eliminated several of these drainages because of vulnerability to high winds, visibility of the sites from Highway 276, and flooding potential. Flooding potential was subjectively assessed at this step on the basis of the size of the catchment area upstream from a potential tailings basin. A large upstream catchment is generally associated with a requirement for additional storage capacity in the basin or the need to build runoff diversion structures. This consideration was a reiteration and refinement of the hydrologic constraints to siting identified in the first step of the study.

Selection of Sites

The basin-shaped siting locations identified in the previous step (Figure 3) were studied in the field by the team of professionals in the disciplines of geotechnical engineering, meteorology/air quality, and ecology. Their observations, supplemented by those of the geologist/hydrologist who had visited the area earlier, provided the basis for identifying the five potential sites that are evaluated in the following section. The five sites identified in this step are labeled 2, 4, 5, 9, and 10 on Figure 3.

Ecological Considerations. Most of the potential siting areas observed were dominated by the black brush/mormon tea vegetation association. These areas were briefly evaluated in terms of vegetative diversity, density, and abundance; the extent of existing disturbance; evidence of or importance to wildlife; and the presence of unique or unusual ecological characteristics. Because these preliminary ecological assessments did not indicate strong differentiation among locations, ecological information did not play a dominant role in further site screening. Rather, the ecological descriptions were carried forward in the study to be used in individual site evaluations.

Meteorology/Air Quality Considerations. Each of the potential tailings impoundment locations visited was assessed for:

- protection from strong winds
- atmospheric dispersion potential for pollutants
- proximity and wind direction to existing and potentially populated areas
- proximity and wind direction to potential plant sites associated with each basin
- probable surface area of tailings (associated with the potential magnitude of emission problems)

Several locations were discounted or eliminated from further consideration because of relative susceptibility to high winds; proximity to a potential townsite for the Bullfrog community at T36S, R11E, Section 16; location of potential plant sites relative to the expected dominant wind direction; or a combination of poor atmospheric and locational characteristics. The assessments made at each location are summarized in Appendix A.

Geotechnical and Geological Considerations. A variety of engineering and geologic conditions were studied at each location. These conditions

were generally related to the feasibility of constructing both a plant and a tailings basin at a given location, requirements for earthwork and site preparation, and the need for special structures or construction methods. Several locations were eliminated from further consideration on the basis of these observations, for reasons related to the following general topics.

Topography. The area and capacity of each potential basin location was roughly estimated. Only basins that could be impounded to contain the required volume of about 2600 acre-feet or more were considered. Sufficient area for a plant site (about 20 acres) generally required that a fairly level or planable plant site that was uphill and upwind from a potential tailings basin location be found nearby. A final topographic consideration was access; hence locations that were close to existing roads and to which access could be readily developed with low grades and low vertical rise were preferred.

Foundation Materials. The location and probable axis of a dam(s) at each location were estimated, and the adequacy of rock materials for dam foundations and abutments in that location was assessed. Foundation conditions at potential plant sites were also estimated.

Seepage Potential. The possibility of seepage both through the dam and through the floor of the tailings basin was considered for each location. For locations where an earth dam was indicated, the availability of materials suitable for an impervious core was assessed. In many cases, clays and shales suitable for this purpose were found within or close to the potential basin. The geological characteristics within each potential tailings basin were also noted. Pervious or jointed materials, or the presence of unconformities between geologic formations in the basin, might indicate the need for lining, grouting, or some other remedial measure. In general, it appeared that sealing of the

basin could be accomplished with relatively impermeable materials found at or near the basin site. Locations that would require lining and where no impermeable earth materials were readily available, or locations where the appropriate earth materials for a dam were not at hand, generally were eliminated from further consideration.

Flooding Protection. Two types of flood events were considered at each of the locations. The magnitude of upstream inflow was qualitatively assessed in relation to the need to provide additional storage capacity for runoff in the tailings basin and in relation to the feasibility of providing additional freeboard in the dam design. Where extra capacity and freeboard appeared to be necessary but were unfeasible to develop, the locations were dropped from further study. The potential effects of flooding on the downstream side of the dam were also qualitatively assessed. At some of the locations studied, the indicated dam site was close to the stream bed of Shootering or Hansen Creek. An issue in these locations was the possibility that waters from a probable maximum flood might damage the downstream face of a tailings dam. Locations where downstream flooding protection was needed but not easily accomplished generally were eliminated.

Construction Feasibility. Each of the locations was studied with respect to the ease of access for construction equipment and the availability of working space for such equipment. In some instances the narrow downstream neck of a potential basin was determined to be too small for large earthmoving machines and thus not a feasible location for building an earth dam. In such cases a masonry structure might be used, but unless the potential basin had numerous other overriding advantages, these locations were generally dropped from further study. The need for and feasibility of constructing other facilities at a location, such as access roads, downstream flooding protection, or upstream inflow diversion, were also considered. In this general category of observations, note was made of opportunities or indications for

alternative basin layouts, such as modular or stair-stepped configurations that might offer advantages during development, operation, or reclamation activities.

Construction Economics. Many of the observations described above were used to exclude locations. A tabular summary of the characteristics of these locations, and a summary of the reasons for eliminating all but five of these locations, is given in Appendix A.

At the locations that were retained for consideration as sites, more detailed observations reflecting the economics of developing a tailings basin and plant were made. Typically, these considerations included approximate dam locations and dimensions, descriptions of earthwork requirements, source and availability of earth materials for construction and basin lining, relative elevation from plant site to basin, length of slurry pipeline, distance from the Shootering Canyon mine, and any other notable characteristics that would affect the cost of facilities significantly. This information was carried forward with nonexclusionary ecological and meteorological assessments for use in evaluating potential sites. These evaluations are discussed in Section 4.

4

SUMMARY OF SITE CHARACTERISTICS AND EVALUATION OF SITES

Following the screening process described in the previous section, five potential sites were subjected to further evaluation. A variety of factors were examined in organizing the reconnaissance assessments into summary characteristics for these remaining sites. Engineering/economic considerations included the impoundment shape and the apparent size and number of dams required, access from mine to plant, requirements for flood control protection, access for construction equipment, opportunity for gravity feed from plant to tailings pond, length of slurry pipeline, tailings basin foundation and abutment quality, availability of building and reclamation materials, relative surface area of tailings pond, requirements for basin lining, control of natural surface drainage inflow, flexibility of engineering design, and adequate room for expansion.

Air quality considerations included proximity and location of potential or existing populations, exposure of the site to strong winds, location of plant site relative to tailings impoundment and to the expected direction of strong winds (blowing dust), possible long-term stability of the tailings impoundment with respect to erosion, the influence of local terrain on atmospheric dispersion of pollutants, and the estimated surface area of the tailings impoundment.

Other environmental impact considerations included visibility of the plant and tailings impoundment from the highway or from recreational areas, vegetative cover and diversity on the site, impacts on animal habitats, and aesthetic sensitivity.

Assessments with respect to the above considerations were done in qualitative terms. Systematically organizing the assessment data into tables yielded a useful summary of the acceptable sites and a qualitative comparison in terms of the above considerations. Table 1 summarizes the engineering/economic characteristics, on a qualitative basis, of the five potentially acceptable sites in the Shootering Canyon study area. The factors in this table influence the cost of developing and operating at a site, including the cost of the dam, slurry pipeline, reclamation, flood and surface drainage control measures, and transport of ore to the plant. In this study, only qualitative assessments were possible for each engineering/economic factor.

Table 1 indicates that Location 2 received relatively favorable assessments on all the factors except perhaps haulage distance to the Shootering Canyon mine. However, it does have very good road access for ore coming from other areas. Locations 4, 5, and 10 may require limited flood control protection. Location 9 has favorable assessments on the flood and surface drainage control requirements but potentially includes a relatively large surface area for the tailings pond. Both Locations 2 and 9 offer more flexibility of design than the others. Site 10 has the favorable feature of a short distance to the mine and a potentially short slurry pipeline. Considering the engineering/economic assessments in Table 1, it appears that Locations 2, 9, and 10 should be considered for further detailed evaluation.

Table 2 presents summary characteristics of environmental impacts for the five potentially acceptable sites in Shootering Canyon. Location 2 has the most favorable assessments on all the factors in the table. There is relatively little difference among Locations 4, 5, 9, and 10 with respect to the factors in Table 2.

Table 1. ENGINEERING/ECONOMIC CHARACTERISTICS OF POTENTIALLY ACCEPTABLE SHOOTERING CANYON SITES

Characteristic	Location 2	Location 4	Location 5	Location 9	Location 10
Number of dams required	1 or 2	At least 2	At least 2	1 or 2	Possibly 2
Access from mine to plant	7 miles; good	6.5 miles; good	6 miles; good	3.5 miles; needs improvement	3+ miles; very good
Requirements for flood control protection	Minor	Significant	Significant	None	Significant
Access for building equipment	Very good	Good	Good	Good	Good
Gravity flow from plant to pond	Excellent	Adequate	Adequate	Adequate	Adequate
Length of slurry pipeline	Moderate	Moderate	Moderate	Moderate to long	Short
Foundation and abutment quality	Very good	Good	Good	Good	Good
Availability of building and reclamation materials	Good	Fair	Fair to adequate	Good	Fair to adequate
Tailings pond surface area	Moderate to large	Moderate	Moderate	Moderate to large	Moderate
Requirements for basin lining	Not likely	Not likely	Not likely	Not likely	Not likely
Control of surface drainage inflow	Minor	Minor	Minor	Minor	Minor
Flexibility of engineering design	Good	Fair	Fair	Good	Fair
Expansion capability	Yes	Yes	Yes	Yes	Yes

Table 2. ENVIRONMENTAL IMPACT CHARACTERISTICS OF POTENTIALLY ACCEPTABLE SHOOTERING CANYON LOCATIONS

Characteristic	Location 2	Location 4	Location 5	Location 9	Location 10
Air quality and safety	Acceptable	Questionable	Questionable	Questionable	Questionable
Visibility from highway	Not visible	Not visible	Not visible	Partial concealment	Not visible
Biological impact	Low vegetative diversity; no special habitats	Similar to but slightly less favorable than Location 9	Similar to but slightly less favorable than Location 9	Similar to but slightly less favoroble than Location 2	Similar to but slightly less favorable than Location 4

Questionable = Exposure to possible strong wind; possible terrain interference with adequate atmospheric dispersion; plant site downwind from direction of expected prevailing strong wind; large tailings pond area.

Acceptable = Not adjacent to potential town site; reasonable protection from strong winds; plant site available upwind from expected direction of prevailing strong wind; long-term stability of impoundment expected to be good; reasonably good atmospheric dispersion expected; moderate tailings pond area.

5

CONCLUSIONS AND RECOMMENDATIONS

The siting effort described in this report was designed to rapidly identify a few potential sites in each of the study areas where the likelihood of meeting safety, environmental, and economic objectives was relatively high. Site evaluations were primarily qualitative and are based on the professional judgments of individuals experienced in uranium facility siting.

Woodward-Clyde Consultants found a number of potential locations and reviewed three additional locations suggested by PRL representatives. The most suitable sites were located south of the Shootering Canyon mine area within a mile of Highway 276 or the access road to the mine from the highway.

A prime site and two alternatives, each with somewhat differing characteristics and assets, are recommended by WCC for consideration by PRL, pending more adequate mapping by PRL to permit further engineering evaluation of the specific sites. These sites are listed below in order of their overall preference:

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Each of the above appears, on the basis of available information, to be adequate for the purpose of siting a plant and tailings pond safely, with minimal impact on the natural resources of the area, while

*Numbers in parentheses refer to location designations in Figure 3.

providing ready access from the PRL mine (or other mines, should ore-buying be included in the program). Each of the sites also appears to have sufficient capacity to permit storage of tailings in excess of present estimates and to offer the opportunity for compartmentalization of the tailings impoundment, should that type of impoundment design prove desirable during the active life of the plant.

WCC recommends that detailed topographic mapping of the area, including each of the three recommended sites and associated upper drainage areas, be initiated as soon as possible. Initial engineering and geotechnical investigations should begin at the site selected by PRL as soon as topographic mapping is completed. These investigations should include:

- determination of the impoundment volume and surface area relationship within the basin
- definition of a specific feasible impoundment area within the basin and determination of the location and height of dam(s)
- testing of dam foundation(s) and abutments
- determination of basin floor permeation characteristics above and below the dam(s) considering tailings fluid chemistry
- testing of soil foundation properties for location of heavy and vibrating machinery at the plant site
- preliminary hydrologic engineering evaluations for the purposes of (a) identifying upstream flow bypass requirements, (b) identifying downstream flood protection requirements, (c) determining aquifer characteristics under the site with one or more deep borings (these deep borings can also be used to detect any recoverable uranium ore or other mineral resources beneath the site)

Appendix A

SUMMARY TABLES

The tables in this appendix summarize characteristics of the locations surveyed during the course of this siting study. Many of the locations were screened out upon closer inspection for reasons summarized in Table A-1. Tables A-2 and A-3 present summary characteristics of all the locations. The characteristics listed include engineering/economic, air quality, biological, and other considerations. All the assessments are qualitative in nature because of data and time limitations. The tables provide a basis for the recommendations and conclusions of this report. They also provide a basis for further studies to help verify and improve assessments at particular locations.

Table A-1. SUMMARY OF SCREENING RESULTS FOR POTENTIAL PLANT AND TAILINGS IMPOUNDMENT LOCATIONS, SHOOTERING CANYON

Location	Screening Results
1	Screened out: long dam axis; relatively severe drainage control problems; aesthetic sensitivity
2	Acceptable
3	Screened out: area too small
4	Acceptable
5	Acceptable
6	Screened out: air quality problem for potential population center; need for special design
7	Screened out: air quality problem for potential population center; need for special design
8	Screened out: problem with upstream surface drainage control; severe erosion potential
9	Acceptable
10	Acceptable
11	Screened out: visible from highway; poor access; questionable volume
12	Screened out: visible from highway; poor access; erosion problem
13	Screened out: visible from highway; long dam axis; erosion problem
14	Screened out: severe flood protection requirements; poor topography; no convenient plant sites
15	Screened out: severe surface drainage problems; potential ecological impact
A	Screened out: erosion control problems; poor dam foundation and abutments
B	Screened out: erosion control problems; poor dam foundation and abutments
C	Screened out: many dams required; poor topographic enclosure
Junc. Hwy 276-95	Screened out: no reasonable location with acceptable access; high visibility; high flooding potential near highway

Table A-2. ENGINEERING/ECONOMIC CHARACTERISTICS OF SHOOTERING CANYON LOCATIONS

Characteristic	Location 1	Location 2	Location 3	Location 4	Location 5
Number of dams required	1 or more	1 or 2	1	At least 2	At least 2
Access from mine to plant	7.5 miles; fair	7 miles; good	6 miles; good	6.5 miles; good	6 miles; good
Requirements for flood control protection	Minor	Minor	Possibly significant	Significant	Significant
Access for building equipment	Very good	Very good	Fair	Good	Good
Gravity flow from plant to pond	Adequate	Excellent	Adequate	Adequate	Adequate
Length of slurry pipeline	Moderate	Moderate	Moderate	Moderate	Moderate
Foundation and abutment quality	Fair	Very good	Good	Good	Good
Availability of building and reclamation materials	Adequate	Good	Fair	Fair	Fair to adequate
Tailings pond area	Large	Moderate to large	Small	Moderate	Moderate
Requirements for basin lining	Not likely	Not likely	Not likely	Not likely	Not likely
Control of surface drainage inflow	Severe problem	Minor	Severe (?)	Minor	Minor
Flexibility of engineering design	Fair	Good	Fair	Fair	Fair
Expansion capability	Yes	Yes	No	Yes	Yes

Table A-2 (continued)

Characteristic	Location 6	Location 7	Location 8	Location 9	Location 10
Number of dams required	1-3	1-2	1-4	1-2	Probably 2
Access from mine to plant	5 miles; good	5.5 miles; poor	5 miles; good	3.5 miles; needs improvement	3+ miles; good
Requirements for flood control protection	Possible	None	Possible	None	Significant
Access for building equipment	Poor	Poor	Fair	Good	Good
Gravity flow from plant to pond	Adequate	Adequate	Adequate	Adequate	Adequate
Length of slurry pipeline	Moderate	Moderate	Moderate to long	Moderate to long	Short
Foundation and abutment quality	Very good	Very good	Very good	Good	Good
Availability of building and reclamation materials	Fair	Fair	Fair to adequate	Good	Fair to adequate
Tailings pond area	Moderate	Moderate	Moderate	Moderate to large	Moderate
Requirements for basin lining	Not likely	Not likely	Not likely	Not likely	Not likely
Control of surface drainage inflow	Minor to moderate	Minor to moderate	Very poor	Minimal	Minor
Flexibility of engineering design	Fair	Poor	Good	Good	Fair
Expansion capability	Yes	Yes	Yes	Yes	Yes

Table A-2 (continued)

Characteristic	Location 11	Location 12	Location 13	Location 14	Location 15
Number of dams required	1-2	1-2	1-2	1-2	1-4
Access from mine to plant	4+ miles; fair (with lift)	3 miles; difficult (with lift)	3 miles; difficult (with lift)	1.5 miles; good	6 miles; fair
Requirements for flood control protection	None	None	Possibly significant	Severe	None
Access for building equipment	Fair	Poor	Fair	Fair	Poor
Gravity flow from plant to pond	Fair	Fair	Fair	Fair	Adequate
Length of slurry pipeline	Short	Moderate to long	Moderate	Short	Moderate to long
Foundation and abutment quality	Very good	Fair	Good	Very good	Very good
Availability of building and reclamation materials	Fair to poor	Fair	Fair	Good to adequate	Poor
Tailings pond area	Moderate	Moderate	Moderate to large	Moderate	Moderate
Requirements for basin lining	Possible	Not likely	Not likely	Not likely	Not likely
Control of surface drainage inflow	Minor	Minor	Minor	Minor	Problematic
Flexibility of engineering design	Fair	Fair	Poor	Poor	Fair
Expansion capability	Yes	Yes	Yes	No	Yes

Table A-2 (concluded)

Characteristic	Location A	Location B-1	Location B-2	Location C
Number of dams required	1-3	1	1	4-6
Access from mine to plant	18 miles;* 1000-ft lift	18 miles;* 1000-ft lift	18 miles;* 1000-ft lift	18 miles;* 1000-ft lift
Requirements for flood control protection	None	None	None	None
Access for building equipment	Fair	Good	Good	Good
Gravity flow from plant to pond	Adequate	Adequate	Adequate	Adequate
Length of slurry pipeline	Moderate to long	Moderate to long	Moderate to long	Moderate to long
Foundation and abutment quality	Poor	Poor	Very poor	Good
Availability of building and reclamation materials	Fair	Fair	Fair	Fair to poor
Tailings pond area	Moderate	Large	Moderate	Large
Requirements for basin lining	Not likely	Not likely	Not likely	Not likely
Control of surface drainge inflow	Minor to moderate	Minor to moderate	Minor to moderate	Minor to moderate
Flexibility of engineering design	Poor	Poor	Fair	Fair
Expansion capacity	Yes	Yes	Yes	Yes

*By existing access route.

Table A-3. ENVIRONMENTAL CHARACTERISTICS OF SHOOTERING CANYON LOCATIONS

Location	Air Quality and Safety	Visibility from Highway	Biological Characteristics
1	Questionable	None	---
2	Acceptable	None	Low diversity
3	Acceptable	None	Some cover
4	Questionable	None	Low diversity
5	Questionable	Yes(?)	Low diversity
6	Poor	None	Small seeps
7	Poor	Limited	Small seeps
8	Acceptable	Yes	Significant seep
9	Questionable	Partial concealment	Low diversity
10	Questionable	None	Low diversity
11	Acceptable	High	Some diversity
12	Questionable	High (?)	Increased diversity
13	Questionable	High (?)	Considerable diversity
14	Questionable	None	Increased diversity
15	Acceptable	Pond, no; plant, yes	Significant seep
A	Acceptable	None	Barren
B-1	Questionable	None	Barren
B-2	Acceptable	None	Barren
C	Questionable	Likely	Good wildlife habitat

Poor = Questionable long-term stability of impoundment; possible impact on potential town site

Questionable = Exposure to possible strong wind; possible terrain interference with adequate atmospheric dispersion; plant site downwind from expected direction of prevailing strong wind; large tailings pond area

Acceptable = Not adjacent to potential town site; reasonable protection from strong winds; plant site available upwind from expected direction of prevailing strong wind; long-term stability of impoundment expected to be good; reasonably good atmospheric dispersion expected; moderate tailings pond area